Executive Summary

This report analyzes the competitive implications of the spectrum caps under consideration by the Federal Communications Commission ("Commission") in its *Further Notice of Proposed Rule Making*, dated May 20, 1994. The spectrum caps reflect the Commission's goal of forestalling the exercise of market power in the provision of wireless telephony services. We conclude that caps are likely to have a variety of undesirable effects on the efficiency and rate of technological advance in the wireless telecommunications industry. We explain why a market power theory based solely on use of a given amount of spectrum is not consistent with current theory and evidence in economics. If spectrum is initially allocated subject to a cap, then a superior regulatory policy would be to allow post-auction market transactions in spectrum. Such transactions would not cause inefficiencies due to the exercise of market power because of the ability of the Commission, in conjunction with the federal antitrust agencies, to prevent proposed horizontal mergers that would cause anticompetitive spectrum aggregation.

We explain how caps are likely to introduce dynamic inefficiencies by distorting or impeding industry research and development efforts. These dynamic inefficiencies will likely outweigh the possible economic benefits of a spectrum cap.

We examine the market definition questions raised in the Commission's *Notice*. We find that any cap on cellular and broadband Personal Communications Services ("PCS") should include Enhanced Specialized Mobile Radio ("ESMR") because firms utilizing these frequencies offer services that are substitutes. That is, firms utilizing broadband PCS and ESMR frequencies compete in the same antitrust market. In contrast, services offered via paging, narrowband, and mobile satellite frequencies are not currently substitutes for cellular and broadband PCS services.

Thus, they do not compete in the same antitrust market and so should not be included in a cap applicable to broadband services.

Finally, we discuss the merits of the Commission's proposed five percent ownership attribution standard. As with spectrum caps, we find that a low ownership threshold will likely cause significant market inefficiencies, while a high ownership threshold would not due to the ability of the Commission and the federal antitrust agencies to prohibit proposed aggregations of spectrum that would reduce consumer welfare.

I. Introduction

A. Statement of R. Preston McAfee

My name is R. Preston McAfee. I am the *Rex G. Baker, Jr.*, Professor of Political Economy at the University of Texas at Austin. I am also an academic affiliate of Analysis Group, Inc. Formerly, I was Professor of Economics at the University of Western Ontario. I hold M.S. and Ph.D. degrees from Purdue University, and a B.A. degree from the University of Florida. I am a Co-Editor of the *American Economic Review* and an associate editor of the *Journal of Economic Theory*.

I previously filed comments and reply comments with the Commission on behalf of PacTel Corporation ("PacTel") regarding my recommended auction design for Personal Communication Services ("PCS") spectrum auctions as described in the Commission's Notice of Proposed Rule Making dated October 12, 1993. In addition to my professional work on auctions, which includes twenty articles published in leading professional journals such as the *American Economic Review*, *Econometrica*, and the *Journal of Economic Theory*, as well as my book, *Incentives in Government Procurement* (with John McMillan, published by the University of Toronto Press, 1988), I have also published a number of articles that analyze the ability of firms to exercise market power. I have also served as a consultant to the Antitrust Division of the U.S. Department of Justice and have testified in several antitrust cases. A copy of my curriculum vitae, which provides additional information on my qualifications and background, is attached as an exhibit to this report.

B. Statement of Michael A. Williams

My name is Michael A. Williams. I am a Vice President of Analysis Group, Inc., an economic consulting firm. Formerly, I was an economist with the Antitrust Division of the U.S. Department of Justice. I hold M.A. and Ph.D. degrees from the University of Chicago, and a B.A. degree from the University of California at Santa Barbara. I have performed analyses of horizontal and vertical mergers in a variety of industries that required definition of relevant antitrust markets and determination of the likelihood that the proposed mergers would enable the firms to exercise market power. While at the Department of Justice, I co-authored seven reports filed with the Commission on a variety of telecommunications matters. I have published a number of papers that analyze the ability of firms to exercise market power. I recently published a paper on the history of market definition and the *Horizontal Merger Guidelines* of the U.S. Department of Justice and the Federal Trade Commission. A copy of my curriculum vitae, which provides additional information on my qualifications and background, is attached as an exhibit to this report.

C. Purpose of Statement

In its *Further Notice of Proposed Rule Making* dated May 20, 1994, the Commission requests comment on the merits of placing caps on the amount of spectrum that licensees can hold. The rationale for such caps is that they would constitute an effective method to prevent firms from exercising market power. We have been asked by AirTouch Communications ("AirTouch"), formerly PacTel, to provide an economic analysis of spectrum caps.

Our primary conclusions are that spectrum caps will likely have a variety of undesirable effects on the efficiency and rate of technological advance in the wireless telecommunications industry, and that they are an inefficient and unnecessary policy tool to use in a post-auction environment to prevent the exercise of market power. We explain why a market power theory based solely on use of a given amount of spectrum is not consistent with current theory and evidence in economics. If spectrum is initially allocated subject to a cap, a superior regulatory policy would be allow post-auction market transactions in spectrum. The Commission, in conjunction with the U.S. Department of Justice and the Federal Trade Commission, could examine proposed horizontal acquisitions of spectrum on a case-by-case basis to determine their likely competitive effects. We also explain how caps are likely to introduce dynamic inefficiencies by distorting or impeding industry research and development efforts. These dynamic inefficiencies will likely outweigh the possible economic benefits of a spectrum cap. In addition, we examine the market definition issues raised in the *Notice*. Finally, we discuss why a five percent threshold for ownership attribution is likely to overstate control of spectrum.

The remainder of this report is organized as follows. Section II examines the applicability of a theory of market power based on spectrum ownership rights and discusses related problems of relevant antitrust market definition. Section III discusses how spectrum caps will likely cause dynamic inefficiencies. Section IV analyzes whether caps applicable to broadband PCS should be applied to other services. Section V discusses the merits of the Commission's proposed five percent ownership attribution rule. A summary is provided in Section VI.

II. Market Power and Market Definition

A. Ownership of Spectrum Does Not Automatically Confer Market Power

Market power is the ability to set price above the competitive level. A cap presumes that there is a definite share of spectrum that always confers significant market power. The notion that share can be a *per se* proof of market power has been intensively investigated in recent years by both academic researchers and authorities at the federal antitrust agencies. The consensus opinion is that even a very high share resulting in a concentrated market cannot be accepted as a conclusive indicator of market power without examining other industry characteristics.[1]

Supracompetitive pricing requires explicit or implicit cooperation among competitors. But collusion among rival providers of wireless communications is difficult and unlikely because of the characteristics of wireless services.

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[1] This recent statement is representative of current academic opinion:

> [W]hile it seems likely that increased concentration matters, other things equal, we are very far from having a decent specification of just what the other things are and how to measure them. A policy that uses concentration levels in different industries should be based on a theory that takes into account the many other phenomena that make industries differ in terms of the likelihood of tacit collusion.

Franklin M. Fisher, *Industrial Organization, Economics, and the Law* (MIT Press, 1991), at 202.

The government antitrust guidelines state:

> In a variety of situations, market share and market concentration data may either understate or overstate the likely future competitive significance of a firm or firms in the market.

Merger Guidelines Issued by Justice Department, June 14, 1984, and Accompanying Policy Statement (Bureau of National Affairs, Inc., 1984) at S6.

First, demand for wireless communications services has been growing explosively. There is no evidence that firms have been allocating territories or customers to restrict competition for new business. It would be exceedingly difficult to monitor and enforce any anticompetitive agreement when market conditions are changing so rapidly.

Second, most of the costs of providing wireless services are the fixed costs of maintaining the network facilities. Because the variable costs of each call are close to zero, the revenue from each additional call goes directly to the bottom line. A firm has a great incentive to maximize output in order to maximize its profits. The potential benefits from cheating on an agreement to restrict output make collusive behavior unstable. Moreover, firms are likely to have different cost levels. Collusion is difficult when one firm can profitably set price below a rival's costs.

Finally, the industry is characterized by great technological competition. A firm investing large sums in research and development should be expected to exploit aggressively the cost and quality advantages over its rivals that result from successful innovation. Indeed, collusion in this context would require collectively determining in advance the prices and features of new services before they are developed or proven in the market. We are not aware of any evidence of such behavior in the industry to date.

There are many pitfalls in determining whether a firm's prices are anticompetitive when products are differentiated and technical innovations lead to rapid growth in demand for the firm's products.. At a minimum, it is necessary to inquire whether the firm is earning a rent that comes from a superior product, and whether the firm is pricing to ration scarce capacity. Both alternatives are consistent with competitive behavior and a high market share.

In this context it is informative to examine the behavior of a dominant firm in a related high-technology industry. Intel clearly has a very large share of the market for central processing unit ("CPU") chips for personal computers. The following table indicates Intel's pricing for chips that have been on the market since 1991.

Intel CPU Prices

Product	1991 Price	1994 Price	Percent Change
386SL-20	$145	$51	-65%
386SL-25	$203	$61	-70%
486SX-16	$230	$81	-65%
486SX-20	$260	$81	-69%
486SX-25	$358	$81	-77%
486DX-25	$460	$283	-38%
486DX-33	$460	$283	-38%
486DX-50	$692	$432	-38%

Source: Merrill Lynch Capital Markets, "Intel Corporation Company Report," December 3, 1991 and March 17, 1994.
All data in 1994 dollars.

The decline in Intel's prices has been dramatic. This decline has been accompanied by equally dramatic increases in product performance. Indeed, the Pentium chip is not included in the table because it did not exist in 1991, but it is widely expected to be the mainstream chip in the near future. Moreover, we doubt that Intel could be said to have restricted its output in any meaningful sense. In short, it does not appear that a simple market share theory of market power can account for the behavior of a firm like Intel.

Even if concentration did affect price in telecommunications, there is no empirical basis for establishing 40 MHz as the threshold for the existence of market power for non-cellular providers and 35 MHz as the threshold for cellular providers. Assuming a relevant market definition consisting of 50 MHz of cellular spectrum and 120 MHz of broadband PCS spectrum, this threshold results in a maximum possible share of only 23 percent (40 divided by 170). It is clear that a broader market definition, for example including ESMR spectrum, would imply even smaller maximum shares.

It is not unusual for the leading firm in an industry to have a share considerably above 23 percent. The 1984 *Merger Guidelines* of the U.S. Department of Justice contain specific provisions for firms with pre-acquisition market shares of 35 percent or more.[2] Moreover, the antitrust agencies in recent years have approved many transactions when the proposed merger would create a firm with a share in excess of 23 percent. High share can be justification for scrutinizing a transaction for anticompetitive effects. But there is no justification for choosing any particular level of market share as a cutoff that should automatically block a proposed consolidation of spectrum.

We emphasize that we do not suggest that market power issues are irrelevant when evaluating spectrum aggregations. There may be a role for the cap in assuring that a "deep pocket" does not hoard spectrum at the auction to the detriment of other competitors. Our analysis is intended to show that a simple cap on allowable spectrum ownership is unlikely to be an optimal permanent antitrust policy. There is no basis for making telecommunications uniquely subject to a market share *per se* rule to block spectrum aggregation.

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[2] U.S. Department of Justice Antitrust Division, *Merger Guidelines*, June 14, 1984, p. 16. The provisions were revised in the April 1992 Department of Justice and Federal Trade Commission *Horizontal Merger Guidelines* to include firms with market shares below 35 percent.

B. Proposed Spectrum Aggregations Should Be Examined on a Case-By-Case Basis by the Commission and the Federal Antitrust Agencies

The issue of relevant antitrust market definition has major implications for operation of a spectrum cap. For example, if the market is defined narrowly to include only broadband and ESMR spectrum, then an existing cellular operator will be allowed an additional 10 MHz of broadband and an unrestricted amount of narrowband spectrum. But a broad market definition that includes all Commercial Mobile Radio Services ("CMRS") spectrum may block the same cellular operator from obtaining any narrowband frequencies at all.

Market definition is inherently an empirical analysis concerning which products are good substitutes in consumption. Such an empirical study cannot be resolved on *a priori* or theoretical grounds. To implement a cap requires determining, at a minimum, which of cellular, broadband PCS, narrowband PCS, private paging, ESMR, and satellite communications belong in the same market for antitrust purposes. Indeed, what matters for market definition is not spectrum in itself but the nature of the large and growing number of services offered on each band. This is a formidable problem, given the limited current level of knowledge about consumer demand for these services. Experts probably will not agree how to classify spectrum categories even along such fundamental dimensions as whether they are substitutes or complements.

It seems clear that the relatively near future will witness a huge growth in the sophistication of wireless services, but it is impossible to predict which services will be successful using which technologies on which frequencies. Satellite PCS is the clearest example because these services do not yet exist. The trade press is also rife with speculation about the future applications of Personal Digital Assistants ("PDA"), although these products are still for the most part on the drawing boards.

The conclusion of this analysis is that it is premature, given the stage of evolution of industry, to commit to a particular, overarching market definition for CMRS spectrum and services. Any market definition is likely to require constant revision, or at least review, because of technological change. Moreover, any definition will lead to ongoing controversy and even litigation. For this reason we would expect the scope of the cap to change over time. In our opinion, these determinations require case-by-case study in which the Commission could rely in part on the expertise of the federal antitrust agencies.

If the scope of the cap does change, then it is likely that at least some firms will have to divest spectrum and other firms will become free to acquire additional spectrum. These sorts of transactions are fundamentally different from a post-auction spectrum market subject to antitrust scrutiny as discussed above. The reason is that the federal government—not the market—would determine the appropriate aggregation and ownership of spectrum. Taking the additional step of allowing all firms the right to propose spectrum transactions with the burden of showing no anticompetitive effects is the best way to keep market definition current and relevant on a case-by-case basis.

A primary conclusion of this analysis is that any caps on spectrum ownership should be relatively high. The costs of low caps are manifold, for the above reasons as well as those discussed in Section III, while the costs of high caps are likely to be low. High caps will not lead to the exercise of market power, but rather to case-by-case examinations by the Commission and the federal antitrust agencies of proposed horizontal aggregations of spectrum.

III. Dynamic Inefficiencies

A. Dynamic Inefficiency Caused By Spectrum Caps Will Harm Consumers

Spectrum caps will cause several negative effects on competition by introducing "dynamic inefficiency," i.e., adverse impacts on the evolution of industry market structure and on the pace and direction of technological change. The caps penalize successful firms who are unable to grow. This has the unfortunate effect of raising the cost of service, and so raising prices to consumers, because inefficient firms are protected from more efficient rivals. Thus, over time the caps will bias the evolution of the industry market structure, i.e., the size distribution of firms. Firms that grow by offering services demanded by customers will be penalized, while firms with stagnant growth resulting from the provision of relatively undesirable services will be protected from vigorous competition.

Furthermore, as discussed in detail below, the pace and direction of technologic change will also be biased by spectrum caps. Firms will have an incentive to invest in technologies that increase the number of circuits per MHz, rather than investing in technologies that allow the use of more spectrum at frequencies not currently commercially useful. As this bias in research and development spending continues over time, the commercial useful technologies will deviate more and more from the economically efficient technologies. This will cause costs to rise relative to what they would have been had the efficient technology been used, which will result in higher prices to consumers.

B. A Cap Creates an Output Restriction

Antitrust policy is intended to prevent non-competitive output restrictions. But a cap clearly restricts the output of a successful firm. Because the wireless telecommunications industry is characterized by intensive technological competition, each stage of the evolution of the industry will likely produce "hit" firms and products that will attract the greatest number of consumers. A cap creates a significant disincentive to invest in a technologically risky endeavor because the returns to successful innovation will be reduced.

As discussed above, it would be a major economic error to attribute a price premium to a non-competitive output restriction. Indeed, the output restriction created by a spectrum cap is likely to have a far greater adverse impact on consumer welfare. Consider how a cap would work in other industries with hugely successful companies:

- Microsoft: banned from selling more copies of Windows?
- Sony: banned from selling more Walkmen?
- Intel: banned from selling more 486 chips?

Another dramatic example of a "hit" technology is Nintendo, which went from start-up to over $2 billion in sales in under three years.[3] These examples demonstrate the economic error of equating high sales with harm to the consumer.

[3] See Harold L. Vogel, *Entertainment Industry Economics*, (Cambridge U.K: Cambridge University Press, 1990), p. 205.

C. A Cap Reduces Economies of Scope

Telecommunications firms are characterized by extensive economies of scope. Scope economies allow a single firm to provide a bundle of different services at lower total cost than separate, stand-alone suppliers. By reducing the amount of spectrum available to successful, multi-product firms, a cap is likely to raise total industry costs. That is, to the extent that a cap will prevent firms from efficiently combining broadband, narrowband, and satellite operations into a single service, society is deprived of the maximum benefits from economies of scope.

The trade press strongly suggests that firms believe consumers will demand a comprehensive array of telecommunications services from a provider. A recent article quotes executives from paging companies as follows:[4]

- "You have an opportunity to have PDAs on your networks, to have laptops on your networks – there's a proliferation of devices that can all use your network and increase your utilization."
- "Already in the works is a trial of a long-distance outcall service.... Up and running is a fax store-and-forward capability.... The real opportunities lie in finding new ways to utilize this nationwide network."
- "Customers want integration with other communications services such as electronic mail and fax, integration with information and data services such as Dow Jones and Reuters, and integration with many types of computing and telecommunications devices such as cellular phones."

As another example:[5]

- "The PCSAT (Personal Communications Satellite) filing shows that the company intends to use the PCSAT system for more than just PCS, including integrated services digital network (ISDN) applications, and video and data from a fixed

[4] From Michael Vernetti, "Nationwide Paging Networks: Wireless Links to an Array of Services," *PCIA Journal*, February 1994, p. 17.

[5] *Mobile Satellite News*, April 27, 1994, p. 4.

> location. In addition, the company may use PCSAT for add-on capability to the MSAT system."

Economies of scope pertain to costs on the supply side of the market and make it efficient for one firm to provide a variety of services. But even if there were no identifiable economies of scope, consumers may still highly value the simplicity of "one stop shopping." Especially as new products are introduced, it could be very advantageous for consumers to purchase services that are designed around a single software interface and a single hardware standard. We conclude that both supply and demand considerations make it likely that a cap will cause welfare losses because firms will not be able to offer an efficient array of products.

D. A Cap Is Likely to Distort Technological Development

A spectrum cap will bias research and development efforts in the direction of signal compression and spectrum sharing technologies so that a successful firm can expand output. However, this is likely to raise the cost of additional capacity significantly compared to utilization of more spectrum. In addition, firms will have reduced incentives to develop new technologies for frequencies which they are blocked from utilizing because of cap restrictions. Both effects represent efficiency losses.

An example of how spectrum caps will distort research and development choices can be seen in the likely future development of the *Ku* and *Ka* bands. These high-frequency bands are not presently commercially useful for wireless mobile telecommunications because the presence of water vapor in the atmosphere causes attenuation of signal propagation. As a result, radio technologies for these bands are relatively underdeveloped relative to technologies available for lower bands. Technological innovations will likely enable firms to use these bands in the future for wireless mobile telecommunications. However, firms constrained by spectrum caps will have little incentive to devote resources to such research and development efforts. Instead, their efforts will be biased in favor of digital compression technologies. Firms not constrained by spectrum caps, e.g., foreign wireless firms, can be expected to explore and develop the use of these high-frequency bands to provide wireless mobile telecommunications. Thus, Commission policies designed to prevent the exercise of market power will likely distort U.S. firms' decisions regarding how to utilize their research and development resources, while at the same time providing a competitive advantage to foreign firms not constrained by the caps.

E. A Cap May Handicap U.S. Firms in Competing Internationally

Exports of wireless telecommunications equipment, maintenance services, production facilities, manufacturing licenses, and technical expertise are likely to be an increasingly important source of earnings for U.S. companies. In addition, global partnerships will likely become increasingly important for success in international competition. A cap may reduce the attractiveness of U.S. firms for at least two reasons. First, a cap may make it too costly for a firm to offer a particular spectrum or technology in demand overseas if it is barred from providing the same product domestically. Second, a cap may make it impossible for a U.S. firm to integrate its services with a foreign partner's network if certain frequencies or services are unavailable.

IV. Caps on Broadband PCS Should Be Applied to ESMRs But Not to Paging, Narrowband PCS, or Mobile Satellite Services

A. Available Evidence Shows ESMR Competes with Cellular and Broadband PCS

Based on current market conditions, there is a reasonable basis for considering cellular and ESMR as substantially similar services. MCI has announced a $1.3 billion investment in Nextel to develop an ESMR alternative to conventional cellular and broadband PCS. This is powerful evidence that major industry participants believe that these two services compete. In addition, industry analysts have identified other ESMR companies, such as Pittencrieff Communications, Inc., that are likely to be taken over as part of similar efforts to exploit potentially underutilized business radio spectrum.[6] Because ESMR has a high potential to become a significant competitor with other cellular and broadband PCS services, it is appropriate to include ESMR spectrum toward the auction cap limits. Otherwise, non-ESMR-based firms will be placed at a competitive disadvantage.

B. Paging and Narrowband PCS Are Complements to Broadband Service

Narrowband service at this time appears to be a complement to broadband services - not a substitute. Narrowband communication typically consists of a one-way page followed by a two-way call. For the present, at least, narrowband and broadband should not be considered substantially similar services.

The situation is much more uncertain regarding the future relationship of narrowband services to broadband. A large number of firms are developing many new features for existing

[6] See Warren Getler, "Small Stock Focus," *Wall Street Journal*, March 7, 1994.

one-way systems. These innovations include expanded geographic coverage, increased transmission rates, and greater message lengths and modes (tone, voice, text, data, and video). It is our understanding that there is great uncertainty regarding whether narrowband technologies will be economic providers of two-way services. In addition, while it seems likely that cellular and other broadband systems will be used increasingly for data transmission, there is no way at present to know whether this possible horizontal overlap will be extensive enough to warrant reconsideration of the current complementary relationship between broadband and narrowband services.

Our view is that it is advisable not to include narrowband spectrum under a cap with broadband. The better course would be to defer making the determination of whether the two services are economic substitutes until new commercially successful technologies become established. As discussed above, the antitrust agencies will be capable of performing these analyses as circumstances warrant.

C. Satellite and Cellular Service Will Likely Compete In Separate Markets

It is also premature to reach any definite conclusion regarding the eventual role of satellite mobile and PCS services because mobile satellite systems have not yet been constructed. However, many of the proposed plans appear to have the implication that satellite PCS will be a complement to cellular service rather than a substitute. Moreover, even when satellite PCS technically might substitute for cellular, any actual satellite system will compete in separate geographic markets. For example, satellite PCS is envisioned in many proposals to fill gaps in cellular coverage in sparsely populated regions. In addition, satellite PCS may be used to provide "global roaming" outside of any cellular provider's licensed service area. As a result, it does not seem appropriate at this time to consider satellite-based services and cellular services as substantially similar, and they should not be included under a common cap.

The major proposed satellite systems are summarized in the following list.

- IRIDIUM (Motorola)- TDMA system designed to employ satellites with on-board processing inter-satellite links which would enable the system to bypass the public switched network if it so desires.

- GLOBALSTAR (Loral/Qualcomm, AirTouch) - system designed as an extension to the current CDMA cellular services and will in no way compete directly with established mobile networks.

- ODYSSEY (TRW, Inc.) - CDMA system designed to work closely with public switched networks via regional gateway control terminals.

- ARIES (Constellation Communications) - CDMA system designed to work with public switched networks.

- ELLIPSO (Harris Corp.) - CDMA system proposes to use 24 satellites.

- INMARSAT (International Maritime Satellite Organization) - is conducting a detailed study of mobile satellite communications called "Project 21," as well as studying Globalstar and other commercially proposed low earth orbit mobile satellite communication systems.

- AMSC (McCaw) - is a geosynchronous satellite system which would provide mobile service only to motor vehicles and only within the U.S.

A typical call on most systems will have a handheld unit on one end that uses both a satellite link and one or more cellular or landline links to reach the other end, indicating that satellite is a complement to other terrestrial networks. Moreover, most systems are specifically intended to provide worldwide roaming and coverage in areas not currently served by cellular, suggesting that the horizontal overlap with regional cellular systems may be insignificant.

Furthermore, the capacities of mobile wireless satellite services are so low relative to cellular that satellite services cannot serve as an effective substitute to cellular services. For example, the IRIDIUM, GLOBALSTAR, and ELLIPSO systems can each carry only 6,000 voice circuits, while ODYSSEY has an even smaller capacity at only 4,500 voice circuits. These capacities contrast with the presence in Los Angeles alone of over 25,000 voice circuits. Thus, on a nationwide basis, the total capacity of mobile satellite services is only a small fraction of the total capacity of cellular services, which will grow appreciably with the completion of the broadband auction.

D. Shared Spectrum Ownership Should Not Be Included Under a Cap

It is our understanding that several frequency bands are likely to be assigned for use by multiple service providers using spectrum sharing broadcast technologies, e.g., code division multiple access ("CDMA"). Because these technologies deconcentrate spectrum, a firm's use of shared spectrum should not be counted for purposes of a cap. There is no exclusive right of use regarding shared spectrum so that entry by new competitors is in principle unrestricted.

A simple example shows why it would not make sense to include shared spectrum for the cap. Suppose the relevant market for the cap is defined as 50 MHz of conventional cellular spectrum and 50 MHz of shared spectrum, for a total of 100 MHz. Suppose there are two licensed cellular firms, with 25 MHz each. Finally, suppose that CDMA technology is available to all firms in the industry. If all spectrum is included in the cap, each cellular firm would be assigned a 75 percent share (25 plus 50 divided by 100). Any firm that just operated in the shared band would be assigned a 50 percent share. It is clearly meaningless to use a methodology where shares add up to more than 100 percent. In fact, there is no upper limit to the sum of shares as the number of firms increases.

V. Ownership Attribution Threshold of Five Percent Overstates Competitive Significance of Non-Majority Interests

A non-majority owner's ability to control depends on the distribution of share ownership. Such an owner is unlikely to exercise control with a share substantially smaller than the average holding.[7] There are several factors that support a relatively high threshold for ownership attribution. First, a high threshold allows for more complex ownership structures and more efficient formation of consortia. Second, a relatively high threshold reduces the threat of divestiture which will likely increase participation in PCS auctions. Third, a high threshold reduces administrative complexity on the part of the Commission while at the same time retaining the oversight of the U.S. Department of Justice and the Federal Trade Commission.

Conversely, a low spectrum ownership cap may have a dampening effect on the willingness of firms and entrepreneurs to invest capital in firms, especially small firms in need of capital. As discussed below, the available empirical evidence on the ownership shares of existing wireless telecommunications joint ventures suggests that a five percent threshold will likely prevent investment by non-majority owners. There is only a limited amount of publicly available information about the size distribution of non-majority holdings in wireless telecommunications companies. However, the data we have been able to locate suggests that a five percent share is much smaller than the average share in these ventures, implying that a five percent owner is

[7] As an empirical matter, in 78 percent of *Fortune 500* firms, the largest shareholder owns at least five percent of the firm, and the average holding of the five largest shareholders is 29 percent (see Schleifer and Vishney, *Journal of Political Economy*, 1986). Thus, non-majority shareholders generally face several other owners with significant ownership shares, limiting the ability of any one non-majority owner to exercise control.

unlikely to exercise control. The five percent attribution threshold is more likely to cause harm by reducing the ability to form efficient joint ventures and retarding investment in the industry.

The table below presents the joint ventures we have identified in the trade press and any associated information about ownership shares. The information in the table suggests that complex ownership structures may be an important mechanism to manage the risk facing investors in a technologically complex and innovative industry such as wireless communications.

Telecommunications Joint Ventures and Ownership Shares

Source	Date	Description
Communications Week	10/25/93	Ardis, a joint venture of IBM and Motorola, formed in April of 1990 to work on applications for mobile computing users.
Communications Week	10/25/93	RAM Mobile Data Inc., co-owned by RAM Broadcasting Corp. and BellSouth Enterprises, formed to work on applications for mobile computing users.
Wall Street Journal	2/28/94	MCI has begun building local phone networks in 20 U.S. cities. MCI is getting help to finance the endeavor from its 20% owner, British Telecommunications PLC. BT is paying $4.3 billion in cash for its MCI stake.
		MCI has an agreement to share traffic with Stentor, a consortium that is Canada's largest long-distance carrier.
		MCI recently announced plans to build a network in Mexico with Groupo Financiero Banamex Accival.
Wall Street Journal	3/1/94	MCI agreed to pay $1.3 billion for a 17% stake in wireless-service provider Nextel Communications Inc. Other shareholders in Nextel are: Comcast (17.5%), Motorola Inc. (20%), Matsushita of Japan (5%), and Nippon Telegraph & Telephone (1%).
The Independent (U.K.)	2/9/94	Vodafone pays 29 million pounds to France's Compagnie Generale des Eaux for a 33 percent share of GMC, the parent company of Talkland, the leading independent mobile telephone service in the UK. Talkland is an intermediary that buys airtime from Vodafone and its rival Cellnet.
Financial Times (U.K.)	4/28/94	Hutchison Telecom is owned by Hutchison Whampoa (65 percent), British Aerospace (30 percent), Barclays (5 percent). BAe and Barclays had both told Hutchison Telecom that they wanted to sell their stakes and Hutchison Whampoa did not want to fund the business alone. During this period talks were held with a number of overseas telephone companies including several US Baby Bells.

The five percent attribution threshold can have exceedingly restrictive effects on investor participation in PCS ventures. Consider, for example, an investor with a five percent stake in a firm that in turn has a five percent interest in another firm owning a 40 MHz PCS license. Under the currently proposed attribution rules, the investor would be barred from owning as much as five percent of any other PCS license in the same geographic market. Put differently, a 0.25 percent share in one license (five percent of five percent) is sufficient to subject an investor to the full force of the spectrum cap. This does not seem reasonable.

In our opinion, it would be preferable to make two changes to the currently proposed five percent attribution threshold. First, the threshold should be raised to a relatively high level, e.g., 20 percent. Second, ownership percentages should be multiplied through when the investor's interest in a license is not direct.